proof in any case that they flowed out at the surface as lavas. Like the gabbros, they were developed in special centers and preferentially in the areas already chosen by the gabbros; hence, the black, rugged mountains of gabbro are very generally accompanied by more or less regularly formed cones of granite and granophyre. These two cones not only form a striking contrast to the gabbros as regards their contour, but also in their colors. They range through various tints of yellow and russet. The characteristic scenery of central Skye, with the dark, rugged outlines of the gabbros on the west and the smooth, pale cones of the Red Hills on the east, depends upon this difference of geologic structure.

The latest phase in the volcanic history is marked by the uprise of another great series of basic dikes which, like those of the earlier time, follow a generally northwesterly direction and rise even through the latest masses of granophyre. On the flanks of the Red Hills of Skye long, dark ribs of rock may occasionally be seen even from a distance, which mark the last efforts of the Tertiary volcanoes of Britain.

W. F. MORSELL.

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*SOME PHASES OF WEED EVOLUTION.**

THE common statement that "a weed is a plant out of place" is by no means satisfactory or final to the student. He is still left to ask how it is that certain species have such pronounced ability for getting out of place. Almost any plant may accidently get where it is not wanted, but comparatively few usually and persistently get in the way. A bad weed species is aggressive and persistent. What qualities make it so?

As a partial answer I would suggest four life attributes as follows: 1. Great reproductive power. 2. Good provision for dissemination. 3. Various protective expedients. 4. Variability.

The statement that a species, to rank as a bad weed, should have large reproductive power needs no elucidation. It is not even necessary to demonstrate that weed species are thus equipped. Dozens of striking examples will occur at first thought.* We should also remember that many of the worst weeds have a double resource for their multiplication; *i. e.*, they propagate themselves by buds as well as by abundant seeds. The Hawkweed throws out stolons; and a Canada Thistle chopped into 20 pieces by the hoe becomes 20 Canada Thistles.

It is also axiomatic that facility of dissemination is one of the qualities of a weed species.

Some weeds make headway by means of special contrivances for avoiding disaster. Certain ones can withstand hard drought. Others have such deep roots as to be beyond the reach of ordinary cultivation. The Dandelion, often cut down by the lawn mower, bears its feathery tuft of seeds on a stem so short as to escape the gardener.

But variability is the chief and most significant quality of a weed species. Moreover, variability is ultimate. And those characteristics already mentioned are all involved in variability; for each one—reproduction, dissemination, protection—may vary, and through selection be indefinitely modified. In this sense, however, variability is not coordinate with the other qualities mentioned.

Other things being equal, then, that species which is most variable is apt to become a weed. This point may be illustrated, though perhaps not demonstrated by reference to some statistics of weed floras. Thus, starting with the proposition that variability is roughly proportional to the number of members in a systematic group,

*Notes from a lecture before the University of Vermont Botanical Club.

*cf. Kerner, 'The Natural History of Plants,' II., 878.

our hypotheses would lead us to the inference that the larger groups would show comparatively large quotas of weed species. Is the inference true?

Professor G. H. Perkins' Flora of Vermont enumerates 114 families of Phænogams and Pteridophytes in the State. Thus if the species were equally divided among all the families each family would include .87 per cent. of the total flora. The great family of Composites, however, contains 10.33 per cent. of all the species in the State. Now, if it contained its fair proportion of weeds it would have about the same percentage. The fact is, it contains 21.43 per cent. of all the weeds and 33.33 per cent. of all the very bad weeds. This family, at any rate, bears out the theory.

These figures with some others appear in the following table:

SOME VERMONT WEED SPECIES.

Family.	Per cent. of total Flora.	Per cent. of total Weeds.	Per cent. of bad Weeds.
Cruciferæ	3.00	6.25	16.67
Leguminosæ	3.33	4.47	5.55
Rosaceæ	4.58	4.47	5.55
Compositæ	10.33	21.43	33.33
Gramineæ	9.42	8.93	11.11
5 Families (5×.87 =4.35 %)	30.66	45.55	72.21

That is, these five great families include nearly one-third the Vermont flora, but nearly one-half the weed species and nearly three-fourths the very bad weeds.

Of course, this does not demonstrate the proposition and there are perplexing exceptions. Thus the largest family in the Vermont flora, the Sedge family, contains not a single species which could be reckoned among the weeds. Nevertheless the family is eminent both as to variability and potential weediness. The sedges crowd out pretty much everything else on their own ground, and it is only because the agriculturist seldom enters their favorite territory that their pernicious possibilities do not become realities.

Attention may also be directed to the fact that many bad weeds have escaped from cultivation. Since cultivation usually induces variability, we may suspect that this has been one source of aggressive power in some weed species.

Dr. Asa Gray * pointed out that both our introduced and our native weeds are, to a very great extent, cross-fertilized. This is the more striking taken in connection with the accompanying statement that most of them are, nevertheless, capable of self-fecundation. The latter capability protects them from extinction when cross-pollination is impossible, and the former provision gives rise to effective variability when other plants of proper relationship are near.

Another surprising fact in the natural history of our weeds is the very large proportion of species introduced from Europe. In a list of the twenty worst weeds of New Jersey, prepared by vote, under the direction of Dr. Halsted, there were elected to the twenty highest degrees of noxiousness four natives and sixteen foreigners. I have examined a similarly-prepared list of the eighteen worst weeds of Vermont. This included four indigenous species and fourteen foreigners.

Such a plain fact as this ought to have some intelligible explanation. Dr. Gray, in his paper mentioned, sets down a common reason, namely, that, since the greater part of the Eastern States was originally tree-clad, the native species were such as thrive under forest protection. They are, therefore, unable to make their way in the cleared fields against immigrant species which have been inured to such conditions by centuries of thrifty practice in the open fields of Europe.

But a stranger fact of weed history exists

* *Am. Jour. Sc. and Arts*, 3d Ser., XVIII. (1879), 161. Reprinted in 'Scientific Papers of Asa Gray.'

in the number of species, of which there are several, which have come from Europe with comparatively clean passports to become aggressive and troublesome in America. This is the case with the Hawkweed (*Hieraceum aurantiacum*, Linn.), which is just coming into prominence in some parts of Canada and the Northeastern States.* There are two reasons for this: First, the comparatively very rapid changes, which practically all America has undergone, have largely destroyed the natural equilibrium of species, and this has made it easier for capable weeds to creep in. Second, the principle pointed out long ago by Darwin as 'the good derived from slight changes in the conditions of life,' applies to the case of plants imported from Europe. This 'good' accrues to the species through induced variability.

Even more interesting points of inquiry are revealed when we turn to study the migrations of weeds within the United States. Merely as a suggestion for further work, I have made a few comparisons between Eastern weed floras and that of Kansas. Professor A. S. Hitchcock † enumerates 209 species of Kansas weeds, of which only 51 are foreigners against 158 natives. Even then nearly all the foreign species are specifically stated to be rare in the State. In my own list of the 20 worst weeds of Kansas, instead of the remarkable proportion of foreign species noted in Vermont and New Jersey, there are 6 foreign and 14 native species. It is also interesting to note that exactly half this list is made up of native composites. Of course, we may expect that, as commerce goes on between Kansas and the Atlantic States, the proportion of foreign weeds westward will increase; but we may feel confident that the Daisy, the Hawkweed, and the Kales will find no such easy time making headway against the sunflowers and ragweeds of Kansas as they have had against the modest, shade-loving species of the Eastern States. The native species of Kansas have been used to live in the open country, exposed to fire and drought and browsing herds of buffalo. Now when they find a well plowed field, with perhaps a little irrigation, they are fully prepared to occupy the ground and hold their own against the world.

* See Vermont Exp. Sta. Bull. 56 (1897).

† Kansas Exp. Sta., Bull. 57 (1896).

Then there is the question of these Western species coming east. Sixty-five years ago *Rudbeckia hirta* was unknown east of the Alleghenies, yet now it is widely distributed in the Eastern States. *Coreopsis tinctoria*, Nutt., is a Western Composite and a bad weed, now much cultivated in gardens in America and Europe. From these it has already shown a tendency to escape, and may be counted as a coming weed. *Dysodia chrysanthemoides*, Lag., is said to be coming rapidly eastward. *Artemesia biennis*, Willd., also belongs to this list, and has recently been collected in the railroad and dock yards at Burlington, Vermont. This list might be greatly extended.

It seems probable that the great and variable and geologically modern family Compositæ is destined to play an increasingly important part in the future transformations of American weed floras, and that its representatives will be especially prominent among the successful native weed species, as, indeed, they already are in the weed floras of the Mississippi Valley States.

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THE EFFECT OF THE DENSITY OF THE SURROUNDING GAS ON THE DISCHARGE OF ELECTRIFIED METALS BY X-RAYS.

IT has been found that the rate of discharge which occurs when X-rays strike upon a charged body is affected by the pressure of the gas surrounding such a